



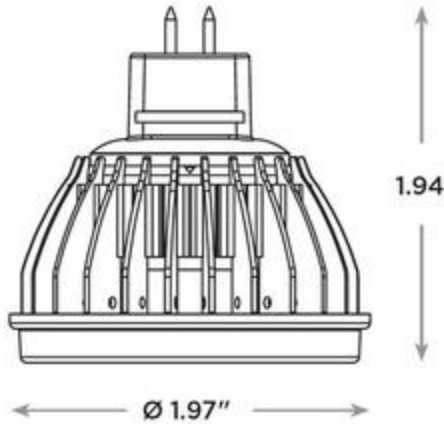
RETHINKING LED LUMINAIRES

Eric Haugaard

Director of Product Technology

What Will the Long Term Form Factors Look Like???

- How is the Mechanical Configuration Constrained



MR16

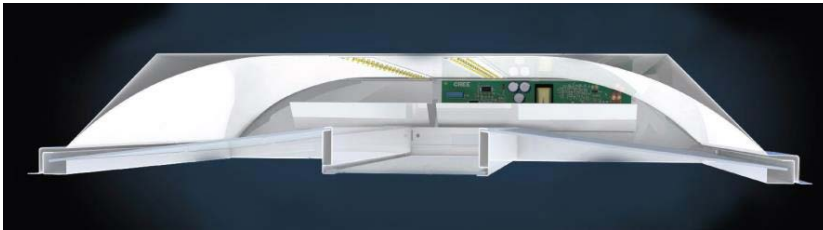


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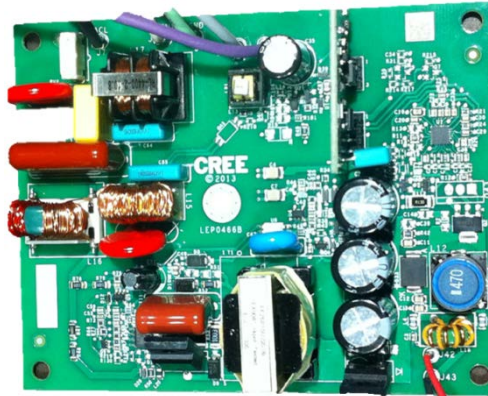
Troffer



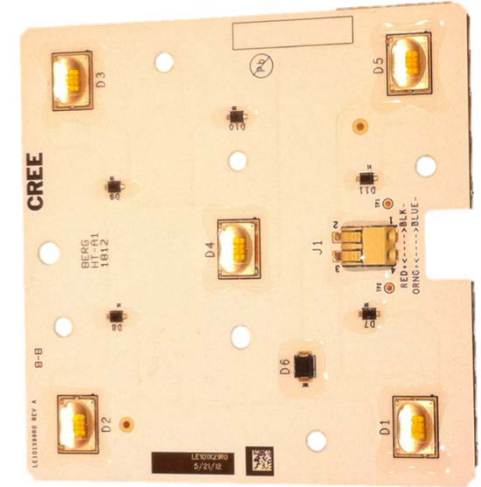
Roadway Luminaires



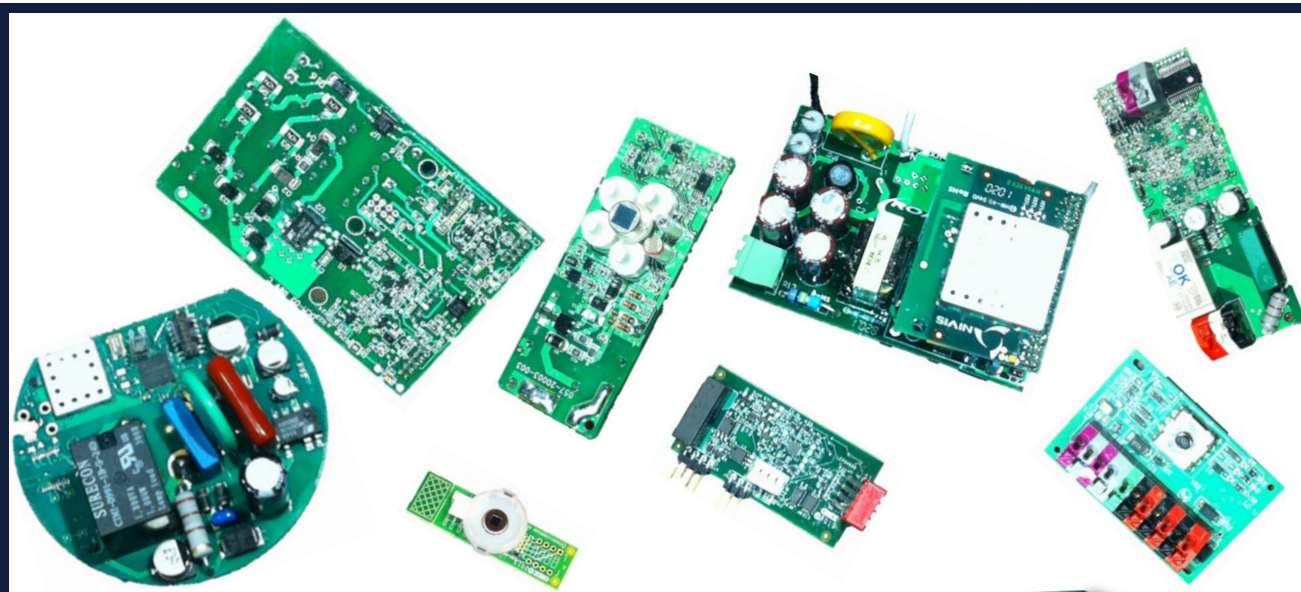
LED Driver



Packaged LED Chips



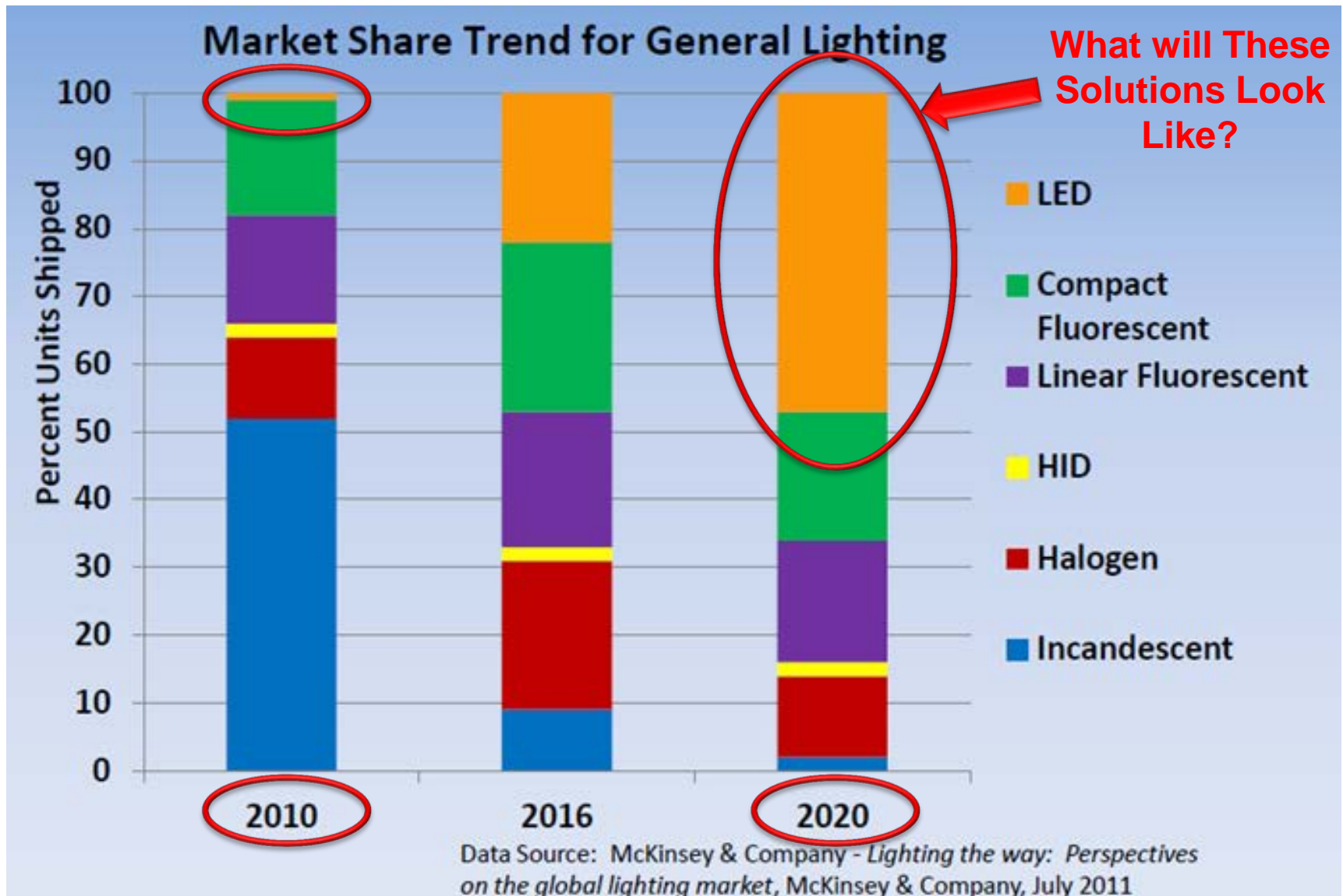
Daylight Sensing
0-10V Dimming
Wireless Control
Occupancy Sensing



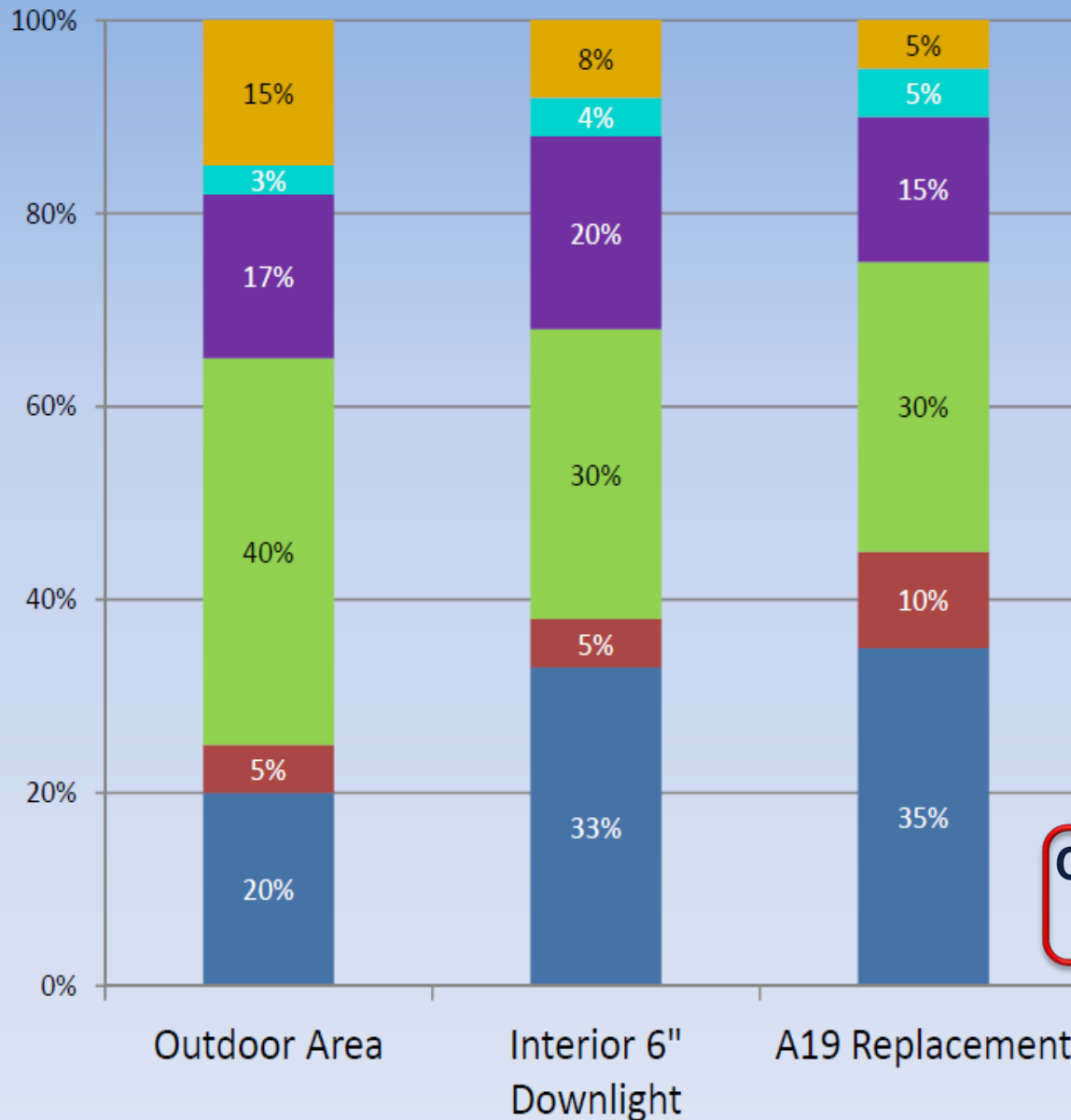
What Will the Products of the Future Look Like?

- New Form Factors
- Smaller Volumetrically / Lighter Weight
 - With Illumination Performance Improvements; Brightness Control, etc.
- Less LED Material at Higher Power???
- More LED Material at Lower Power???
 - Cheaper and Better LEDs
 - Less Heat...
- More Housing Material Options
 - Plastics... Low Environmental Impact Options
- As Close to One Highly Reliable Circuit Board as Possible
 - Fully Populated for all Possible Functionality (Less SKUs)
 - Programed at Factory or During Installation (Commissioning)
 - Populated as Needed (More SKUs, More Inventory Challenges)

LED Adoption Estimates



Cost Breakdown for Various LED Solutions



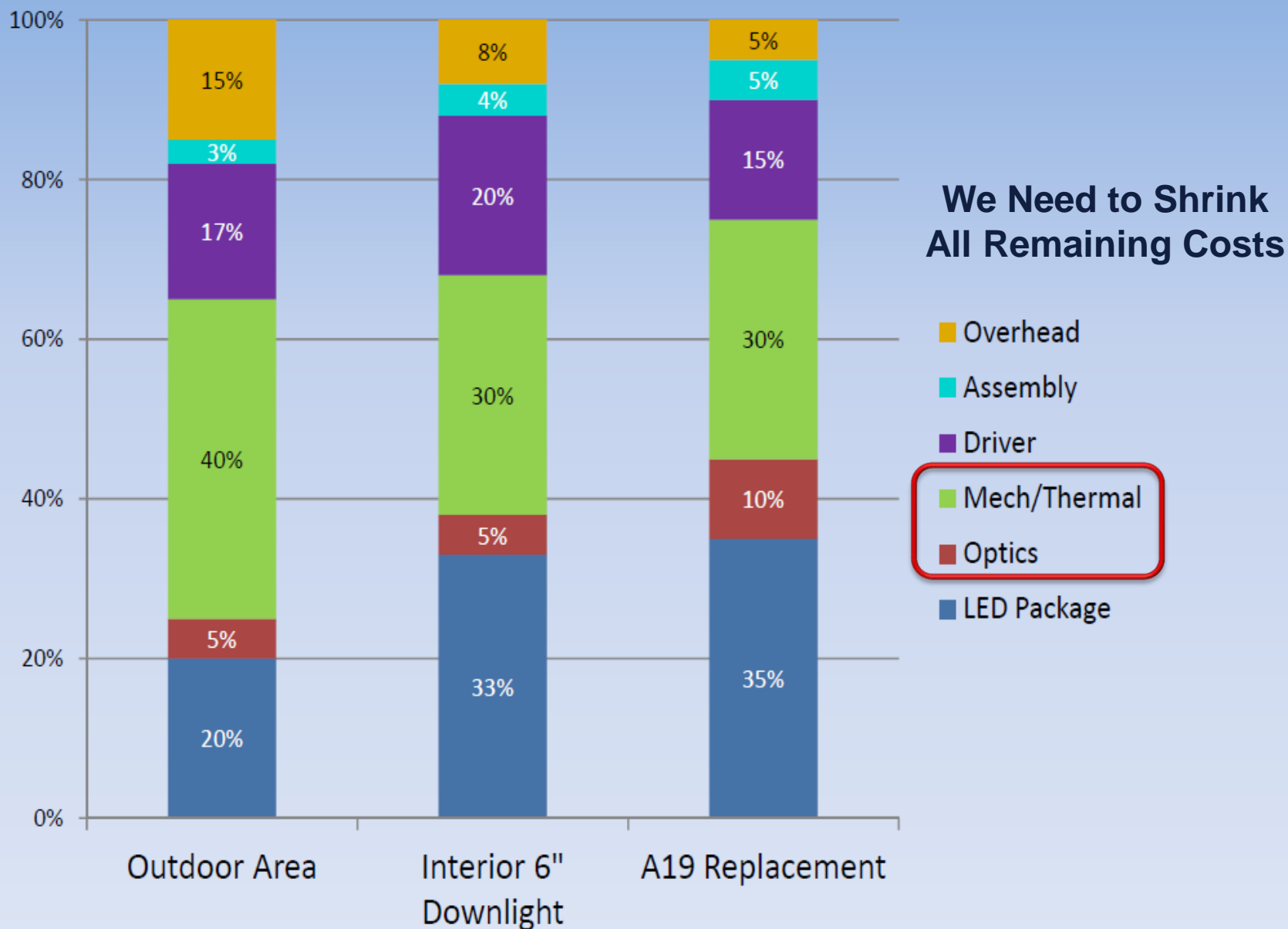
**We Need to Shrink
All Remaining Costs**

Overhead
Assembly
Driver
Mech/Thermal
Optics

LED Package

**Cost Per Delivered Performance
Continues to Shrink**

Cost Breakdown for Various LED Solutions



Data source: DOE R&D Manufacturing Roadmap, September 2013

Luminaire Housing Materials Challenges and Opportunities

What would the ultimate material look like?

- Manufacturability
- Durability
- Safety / Compliance
- Cost
- Etc...

- All of the Good Properties and None of the Bad
 - Aluminum
 - BMC (Thermal Form)
 - Steel
 - ABS
 - Etc...

**We Need to Shrink
All Remaining Costs**

■ Overhead

■ Assembly

■ Driver

■ Mech/Thermal

■ Optics

■ LED Package

Optical Materials

Challenges and Opportunities

What would the ultimate material look like?

- Manufacturability
- Durability
- Optical Properties
- Safety Compliance
- Cost
- Etc...
- All of the Good Properties and None of the Bad
 - Acrylic
 - Polycarbonate
 - Glass
 - Silicone
 - ABS
 - Etc...
 - “Printable” optics?

**We Need to Shrink
All Remaining Costs**

- Overhead
- Assembly
- Driver
- Mech/Thermal
- **Optics**
- LED Package

Thank You!